Low Cost Computerized Digital IC Tester

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***Abstract*--This paper focuses on testing of any available digital IC of the TTL or CMOS family of 24 pins. Since the IC tester is programmable, any number of ICs can be tested within the constraint of the memory available. This model applies the necessary signals to the inputs of the IC, monitoring the outputs at each stage and comparing them with the outputs of the predefined truth table. Any discrepancy in the functioning of the IC results in a fault indication. Otherwise displays the acceptable gates on the LCD as well as the PC screen. In which pin the fault is detected that also is displayed on the LCD as well as PC screen. In this paper ,the device which is been described , basically performs checking work of digital ICs. The working method is very much correct & it performs faster than any other device. Several gates are available in a basic digital IC, whether those gates are correct or not ,that is also been displayed here. The regular digital IC tester available in market costs somewhere round Rs15000/-,but those ones are not computerized as well as very much slow in process. Moreover, it can't store the testing result in the database & these devices can be checked in the filed only, checking via control room isn't possible in this case. In our research work we have designed such a digital IC tester which is removing all the above mentioned drawbacks. The main important fact is the manufacturing cost of the device is not more than Rs600/-**

Keywords- Computerized IC tester; Closed loop device; IC testing device.

I. INTRODUCTION

In electronic industry, with dramatic increase in circuit complexity and the need for the higher levels of reliability, a major contributor cost in any product can be in the testing. The main advantage over the industry standard for the project is its low cost and eases of updating to any new IC design which may be inducted in the market by any company only through software updating [1]. This circuit is based on PIC Microcontroller, where the system is complex in terms of functionality and interfacing. The solution to go beyond the complexity is the advent of SOC (System-on-chip) in recent years.

The digital IC tester [2] is implemented in order to test the digital IC's to verify the faulty gates and the acceptable gates. The necessary inputs to the gates of the IC to be tested [3] which is placed in the ZIF socket is received from the microcontroller IC and corresponding outputs are accumulated and sent to the same controller IC where the output is compared with the functional or the logic table and if any discrepancy results, it displays the fault in the LCD display screen as well as in the PC screen.

The primary purpose of this digital IC tester is that it can easily check the IC within due course of time and if any discrepancy results then it determines the gates which were good ones and which were the bad ones. The manual operation or a human intervention includes testing of each individual IC by making necessary connections and verifying the outputs for each gate by the truth table is a time taking and tedious process.

With the implementation of the microcontroller units interfaced with PC makes the job much easier to receive data for the respective gates and process output and display results [4, 5]. The operation of a PC based [5] controller is determined primarily by its program. The main advantage of this circuit is that whenever a new IC is to be tested [3, 4] it does not include any addition of hardware but a slight updating in the software code is sufficient enough.

The IC tester circuit is one among the many applications of the microcontroller board. The IC which is to be tested is mounted on the ZIF socket. The inputs are fed to the IC which is primarily processed through the slave controller board. The program is written in such a way that comparisons are to be made between the expected data from the truth table and the data that is obtained from the data bus which is nothing but the outputs of the IC that is in testing process. Finally a display has to be made on the LCD display which is located in the main controller board specifying which gates of the IC are working and which are not.

II. WHY DIGITAL IC TESTER

- Digital IC Testers are required in various electronics laboratories and industries for designing and manufacturing different types of electronics devices.
- Instant verification of different ICs become easier and efficient while using and implementing them in different devices.
- Faulty ICs can be detected easily before using them in logic circuit design.
- The using of digital IC tester made the whole process of production of electronics devices cost efficient since faulty ICs can be tested from before hand prior their usage.

A. Features of IC Tester

1) User friendly set up and operates.
2) 16 X 2 character LCD display.

3) Identifies over 10 CMOS / TTL digital ICs (up to 24 pins).

4) Computer and LCD display to present the test results FAULT or ACCEPTED.

5) Computer is used to give the input to the Microcontroller that which IC is testing at present

B. Technical Specification

FAMILY : TTL, CMOS, PIC

RANGE : Logic Gates, Shift Register, Adder and Multiplexer can be tested.

TEST SOCKETS : A single 24 pin ZIF sockets for IC Testing.

PACKAGE : DIP14, 16, 20 and 24 pins.

DISPLAY : 16X2 LCD Display.

KEY PAD : Computer keyboard.

ELECTRICAL : 230 V (+/- 10 %), 1 phase, 50 Hz (+/- 2 %)

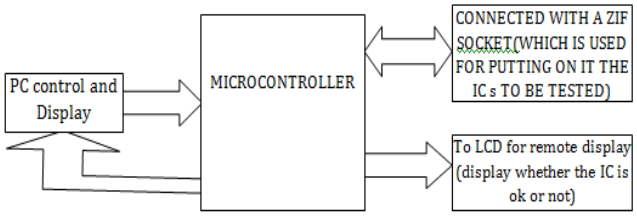

Figure 1. Basic block diagram of digital IC tester.

III. PROPOSAL OF SIMPLE HARDWARE DESIGN

"Simplicity is the ultimate sophistication", to make the system cost effective, responsive and stable enough, we had to focus on the hardware designing part in a simplest way. We, in our prototype circuitry had only used keyboard, 89C51 MCU, one LCD and a few passive components. The block diagram of our project is as Fig. 1.

To design and fabricate a microcontroller based digital IC tester we require to interface LCD with microcontroller which are described below:

- LCD display is used here to display the faulty or acceptable gates, which is easier to interface with the microcontroller and it also has minimum number of pins (11) to connect with the microcontroller. To interface the LCD display with the microcontroller we have connected the port 2 and port 3 of 89C51 with the LCD. The pins 7-14(D0-D7) of LCD are connected with port 2 (21-28) of microcontroller and the pins.
- The IC tester board is containing a 20 pin ZIF socket, in which IC to be tested (here 14 pin IC's only) are kept. Two 8 pin relement connector is used and these two are connected to the port 3 and the remaining 4 pins out of 5 remaining pins of port 1 of microcontroller chip. Again these two 8 pin relement connectors are connected via wires to the 20 pin ZIF socket, according to the pin numbering of the IC to be tested.

A. Logic to test the IC

The logic to test an IC is very simple. We can test it using their truth tables and functional tables. In case of logic gates, we should check truth tables and in case of ICs like shift register, full adder, multiplexer etc we should check functional tables.

Let us take an example of logic gate IC 7400 *i.e.* NAND gate. In this gate first two terminals are the inputs and third terminal is the output. So we are externally giving inputs to first 2 pins of IC and checking the 3rd terminal. If the desired output is obtained, LCD as well as the PC displays IC tested is acceptable and if the output is wrong, LCD displays IC tested is faulty.

- Interfacing the PC with the PIC microcontroller.
- Interfacing the LCD with the microcontroller to get the output in it, that whether the ICs put on the zif socket is ok or faulty.
- Interfacing the zif socket board with the microcontroller.
- Testing and verification of all the gates.
- Verification of the output on the LCD.

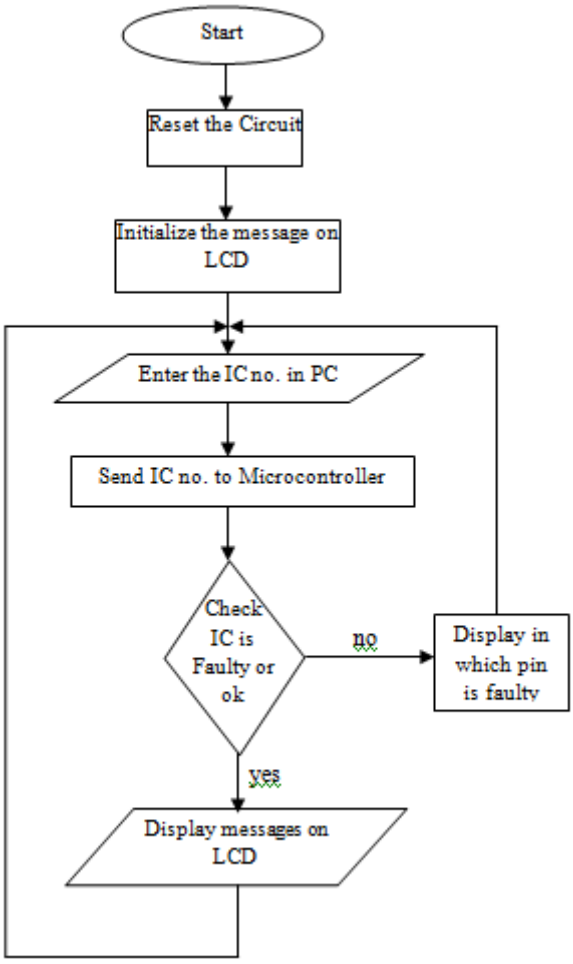

Figure 2. Flow chart of the IC tester program

The main workflow of the system is as follows:

1. Connect the LCD and the tester board with the microcontroller board. This total system is interfaced with PC. A message "DEVICE IS CONNECTED" will be displayed in the PC screen.

2. The IC to be tested is placed on the tester board ZIF socket and enters the IC number from PC.

3. When the IC number is given then it is sent to the microcontroller 89C51. MCU starts executing the program for that particular IC. Then MCU checks accordingly that whether the database on which the program is executed in the MCU is matching with the given IC.

4. If the IC is found to be alright then the program stops executing and shows the message 'IC is OK'.

5. If the IC is found to faulty then the program jumps to the sub-routine program and starts executing to find out in which particular pin the fault is happening. After finding it out the message will show that "IC is faulty" and after some time "The fault is in the X pin" in the LCD as well as in the PC screen.

6. To make the communication bidirectional, a push to on momentary alarm button is placed on the PIC board, which, when pressed, notifies a signal on the software screen.

7. The unit is also capable of being shared over Ethernet via any USB sharing protocol, USBIP, USB over network etc.

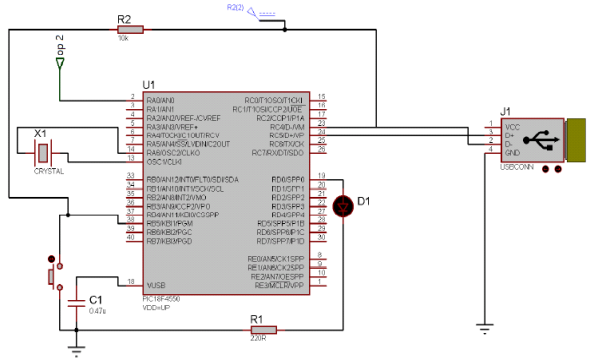

Figure 3. The PIC based Data Acquisition system.

Fig.3 shows the interfacing of USB with the PIC microcontroller. The USB helps the IC tester module to interface with the PC. Whatever the result is coming out of the IC tester module the result is shown in the PC. Not only that but also the IC number is given as input to the IC tester i.e. IC to be tested can be selected from the PC.

The PIC18FX455/X550 device family contains a full-speed and low-speed compatible USB Serial Interface Engine (SIE) that allows fast communication between any USB host and the PIC microcontroller. The SIE can be interfaced directly to the USB, utilizing the internal transceiver, or it can be connected through an external transceiver. An internal 3.3V regulator is also available to power the internal transceiver in 5V applications. Some special hardware features have been included to improve performance. Dual port memory in the device's data memory space (USB RAM) has been supplied to share direct memory access between the microcontroller core and the SIE. Buffer descriptors are also provided, allowing users to freely program endpoint memory usage within the USB RAM space. A Streaming Parallel Port has been provided to support the uninterrupted transfer of large volumes of data, such as isochronous data, to external memory buffers. Fig.4 presents a general overview of the USB peripheral and its features.

IV. EXPERIMENTAL OBSERVATIONS

The hardware implementation of the project is complete. For the initial step, we have bought the components and have made the planning that how we will carry out the entire process in order to implement the hardware. And finally we have prepared the hardware by completing the remaining hardware interfacing parts and we prepared the project report. In this project of 'Digital IC Tester' we have to do different interfacings with the microcontroller board, they are the following-

- LCD interfacing.
- IC tester board interfacing.
- PC interfacing.

After the successful completion of our work we have got the result that any type of IC can be tested by this digital IC tester. The main advantage of this module is it can be operated from a PC. That may be situated in a remote place and can be controlled from a remote place with the help of GSM technology or wireless technology.

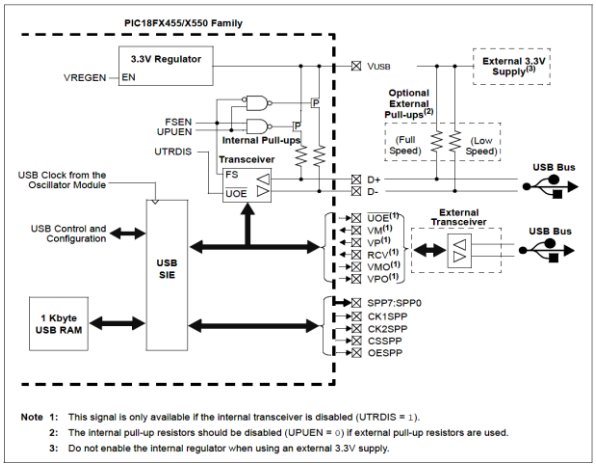

Figure 4. USB Compatibility of PIC

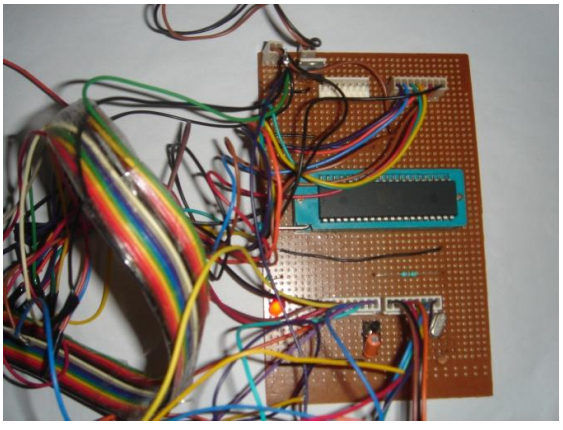

Figure 5. Snapshot of Microcontroller Board.

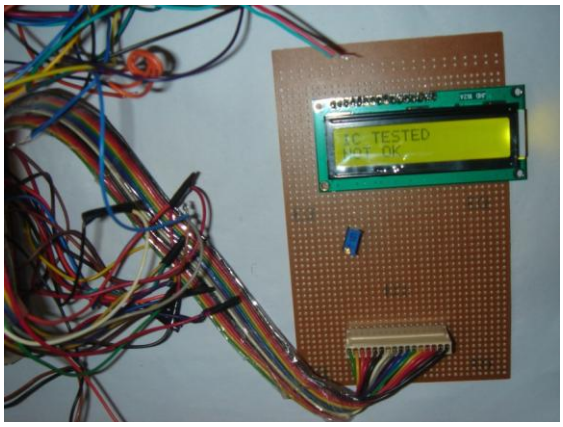

Figure 6. Snapshot of LCD Board

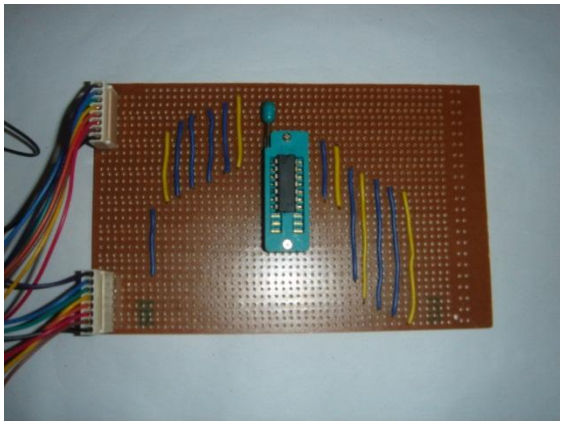

Figure 7. Snapshot of IC Tester board.

V. CONCLUSIONS

The work has been successfully completed and the main objective of emulating an IC tester on PIC micro controller has been achieved. We have designed the hardware and have prepared the project report. For a given specification any IC can be checked for its functionality. It takes more time to test an IC manually, with the implementation of the system with microcontroller makes the testing procedure simpler. The hardware is made with forward compatibility, by changing the program in the microcontroller chip only for testing other fourteen pin ICs.

So we conclude that with the hardware we have prepared, any of the seven IC's (AND, OR, NOT, NOR, NAND, X-OR, X-NOR) OF 74LS series can be tested whether it is acceptable or not.

REFERENCE

[1] G. L. West A microcomputer-controlled testing system for digital integrated circuits, 1976.

[2] Geric A. Agawin, Kristian H.M. Fernando, Claudius Jose A. Yango, "PC based digital logic tester via USB port", Letran-Calamba student research journal, A.Y. 2008-2009.

[3] Sherif Anas Mohamed, In-circuit testing for electronic board, M.Sc. degree, MTC, Cairo, 2006.

[4] A. Jutman, R. Ubar, "Laboratory training for teaching design and test of digital circuits," in Proc. MIXDES Conf., Zakapane, Poland, June 21-23,2001, pp. 521-524.

[5] J. C. Rice, "Base your IC tester on a ÂµP", Electron. Des, pp.88 -92 1976.

[6] The TTL Data Book for Design Engineers, 1976: Texas Instruments, Inc.

[7] A. D. Friedman and P. R. Menon, Fault Detection in Digital Circuits, 1971 :Prentice-Hall.

[8] Digital and Microprocessor Techniques V10, Clive W. Humphris.

[9] Digital System Test and Testable Design, Springer US

[10] Newnes Digital Logic IC Pocket Book (Newnes Electronics Circuits Pocket Book, Volume 3), Elsevier Science.

[11] Designing Embedded Systems with PIC Microcontrollers (Principles and Applications), Elsevier Science.